Microbiological Studies of Coli-aerogenes Bacteria. (III) : Oxidations of Glucose and Pyruvic Acid

AUTHOR(S):

Katagiri, Hideo; Tochikura, Tatsurokuro; Imai, Kazutami

CITATION:

Katagiri, Hideo ...[et al]. Microbiological Studies of Coli-aerogenes Bacteria. (III) : Oxidations of Glucose and Pyruvic Acid. Bulletin of the Institute for Chemical Research, Kyoto University 1958, 36(4): 115-116

ISSUE DATE:

1958-07-31

URL:

http://hdl.handle.net/2433/75638

ketoglutaric acid by *Ps. fluorescens*. As for *Serratia marsescens*, similar results were obtained by Asai and Aida *et al.* On the contrary, it was demonstrated by us, that 2-ketogluconic acid could not be an intermediate product of α-ketoglutaric acid with *Escherichia coli*, since 2-ketogluconic acid was never detected at any stage of fermentation. It was also found by us that a remarkable amount of α-ketoglutaric acid was already produced in the early stage of fermentation (within 14 hours'culture) by some species of *coli-aerogenes* types.

Phosphoric acid ester of vitamin B_1 has already been pointed out to be the principal component of the coenzyme of the oxidizing systems of pyruvic and α-ketoglutaric acids by Gunsalus *et al.* Therefore, they concluded that vitamin B_1 would reveal such a noticeable effect on the decomposition of α-ketoglutaric acid as it has been already ascertained on the decomposition of pyruvic acid. In our experiments with the bacteria of *coli-aerogenes* types, vitamin B_1 was found to diminish the formation of pyruvic acid, however no effect of vitamin B_1 was observed on the decomposition of α-ketoglutaric acid throughout the fermentation.

Table 1. The production of α-ketoglutaric acid.

Exp. No.	Strain No.	Time of incubation (hrs.)	Initial conc. of glucose (%)	Glucose consumed (g.)	α-Ketoglutaric acid produced (% on consumed glucose)
1	2C	84	5.0	4.94	42.9
2	2C	46	5.0	4.50	42.3
3	B24	60	5.0	4.70	43.6
4	B25	60	6.0	5.58	39.8
5	B24	60	5.0	4.70	44.7
6	B24	120	8.0	7.61	48.8
7	B24	120	8.0	6.70	45.0
8	B25	120	8.0	6.48	51.5
9	2C	140	9.0	8.33	51.0
10	2C	140	9.0	8.83	45.6
11	2C	140	9.0	7.01	49.0
12	5E	115	9.0	9.00	19.5
13	6E	115	9.0	8.88	32.4
14	7E	115	9.0	9.00	33.2
15	8E	115	9.0	8.73	34.4
16	9E	115	9.0	9.00	41.8

Microbiological Studies of *Coli-aerogenes* Bacteria. (III)

Oxidations of Glucose and Pyruvic Acid

Hideo KATAGIRI, Tatsurokuro TOCHIKURA and Kazutami IMAI

(Katagiri Laboratory)

Bulletin of the Agricultural Chemical Society of Japan, **21**, 346 (1957)

The oxidative degradation of glucose by *coli-aerogenes* bacteria was investigated : a remarkable yield (more than 0.5 mole per one mole of glucose) of α-ketoglutaric acid was obtained with suspensions of washed cells of the bacteria grown aerobically on glucose medium, and pyruvic acid fermentation was revealed in the presence of arsenic compounds not only with growing culture but also with the washed cells. Moreover, pyruvic acid was found to be a potent precursor of α-ketoglutaric acid.

Microbiological Studies of *Coli-aerogenes* Bacteria. (IV)

Production of α-Ketoglutaric Acid

Hideo KATAGIRI and Tatsurokuro TOCHIKURA

(Katagiri Laboratory)

Bulletin of the Agricultural Chemical Society of Japan, **21**, 351 (1957)

The formation of α-ketoglutaric acid from pyruvic acid may be represented in the following equation in which the synthesis of the carbon chain would necessarily be involved.

$$2CH_3\cdot COCOOH + 2O \rightarrow HOOC\cdot CO\cdot (CH_2)_2COOH + CO_2 + H_2O \qquad (I)$$

Under the authors' experimental conditions, α-ketoglutaric acid was obtained in such a good yield as 0.5-0.7 mole from two moles of pyruvic acid, that is, the yield amounted to 50-70% of pyruvic acid used. Furthermore the exprimental results with pyruvic acid, not containing high energy phosphate-bond (~Ph) in the molecule, will point out the propriety of the assumption that a major pathway of synthesizing α-ketoglutaric acid would not involve carbon dioxide fixation (oxaloacetic acid formation from pyruvate). On the other hand, phosphoenol pyruvic acid is known to be most effective upon carbon dioxide fixation in both animal and plant tissues. As a further explanation for reaction (I), the following pathway would be possible :

$$\text{2 Pyruvic acid} \xrightarrow{+O} \text{Pyruvic acid} + \text{Acetyl-CoA} \xrightarrow[\text{(Pyruvate-acetate reaction)}]{+O} \alpha\text{-Ketoglutaric acid} + CO_2 + H_2O \qquad (II)$$

The transfomation of lactic acid into α-ketoglutaric acid was confimed to proceed *via* pyruvic acid, based on the results that a minute trace of pyruvic acid could be detected during the oxidation of lactic acid.

From the ecological point of view, it is interesting to note that lactic acid, which is accumulated as the major product without being metabolized in the anaerobic fermentation by the bacteria of *coli-aerogenes*, is available as a source of carbon and moreover is converted in aerobic conditions into α-ketoglutaric acid, which is the precursor of glutamic acid, therefore the starting substance for the syntheses of various amino acids.